

Brookhaven National Laboratory National Synchrotron Light Source		Number: LS-PPS-0015	Revision: E
		Effective: 2/16/06	Page 1 of 11
Subject: <u>SDL Laser Interlock Test</u>			
Prepared/ Approved By:	M. Buckley	Prepared/ Approved By:	S.Buda

*Approval signatures on file with master copy.

[Revision/Periodic Review Log](#)

Test Reason:	Test Result: <input type="checkbox"/> Passed <input type="checkbox"/> Failed	
	Test Type: <input type="checkbox"/> Full <input type="checkbox"/> Partial	
Test Date:	Start Time:	Finish Time:
Tester 1:	Assistant 1:	
Tester 2:	Assistant 2:	

Required Preparation/Prerequisites:

- ☐ Inform the experimenter that a test of the laser interlock is being performed.
- ☐ A qualified SDL laser operator must be available to assist in placing Safeguards (Beam-Dumps) at the output of each laser system as indicated below and to place the laser systems in a "Ready-Mode" where the power supplies will be on with no laser output.
 - Place beam-dump/safeguards in place and LOTO Ti-Sapphire shutter and amplifier enclosure.
 - ☐ Ti-Sapphire laser (Titanium-Sapphire) - located in the Main Laser Hutch (MLH)
 - ☐ Nd: YAG laser (neodymium:yttrium-aluminum-garnet) - Main Laser Hutch (MLH)
- ☐ Obtain system reset key (F-300) and wear shoe covers when entering the laser room.

[Laser Room Search & Access]

1. Press the Start Search button located on the East wall of the laser room.
 Press CS-2 located on the North wall.
 Exit the laser room and press the Complete Search Button.
 Observe the audible warning is a minimum of 15 seconds. _____
2. Press the Laser Power Trip reset button.
 Interlocked sign is illuminated _____
 Laser Room secure light is illuminated on the main control box. _____
 "Doors" light is not illuminated. _____
 Laser Power Trip light out. _____
3. Open the outside door and observe:
 Interlocked sign goes out. _____
 Laser Room secure light goes out. _____
 A Chain Fault is illuminated. _____
 B Chain Fault is illuminated. _____
 Laser Power Trip light is illuminated. _____
 Intermittent audible alarm sounds for 5 seconds. _____

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 2 of 11

4. Press CS-2
The LED on button box does not illuminate _____
Exit the laser room.
5. Press Complete Search Button
LED on button box does illuminate _____
The interlock does not secure _____
6. Press the Start Search button located on the East wall of the laser room.
Press CS-2 located on the North wall.
Exit the laser room.
Press the Complete Search Button.
Open the door and close the door within the time-out period and press
the Complete Search Button,
The interlock does not secure _____
7. Secure the Laser room.
Press the Access/Reset button located on the main control box.
Door Bypass #1 light illuminates. _____
Open the outside door to the laser room
The interlock remains active _____
8. Enter the vestibule and close the door.
Press the Access/Reset #1 button.
The led goes out. _____
9. Press the Access/Reset #2 button.
The LED on the button box lights. _____
The Door Bypass #2 light on the main box
illuminates _____
Open the inside door and enter the laser room.
Press the Access/Reset button inside the laser room.
The LED on the button box goes out. _____
10. Reverse steps 8 & 9 to exit the laser room.
The interlock is maintained. _____
11. From the outside of the Laser Room press the Access/Reset button
located on the main control box.
Open the door and hold open noting the time from when the button was
pressed.
Interlock dumps within a maximum of 20
seconds. _____

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 3 of 11

12. Secure the laser room and enter the vestibule using the buttons.
Once inside the vestibule press the Access/Reset button #2 and open the door. Hold open noting the time from when the button was pressed.
Interlock dumps within a maximum of 20 seconds.

[Door Switches]

13. Verify faults are cleared on the following lasers:

Faults are cleared on the two Yag power supplies

Faults are cleared on Ti Saphire power supply

Reset Laser Power Trip

Place latch devices on the inner and outer door switches.

Search laser room. Remove holder from switch #1.

Interlock drops out.

The A Chain Fault light is illuminated,

Two Yag power supplies trip OFF

Ti Saphire power supply trips OFF

Replace switch holder and reset fault

Main
Inner

Main
Outer

Aux
Inner

Aux
Outer

14. Search the laser room, remove switch #2.

The B Chain Fault light is illuminated.

NA

Reset B chain fault (press complete search button)

15. Remove the holders from the door switches. Stand inside the laser room and open and close the door.

The door switches operate freely and each makes a "click" when door is opened

Inner

Outer

16. Search the Laser Room.

Press the Interlock Off button, open the Inner door, and then repeat for outer door.

The interlock sign goes out when the button is pressed.

There is no audible warning when the door is opened.

Reset laser power trip

SDL Laser Interlock Test				
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 4 of 11	

		Laser Emergency Stop				
		ES-1	ES-2	ES-3	ES-4	ES-5 (Op Console)
17.	[Emergency Stop]					
	Search the laser room and Reset Laser Power Trip.					
	Press an emergency stop					
	The interlock drops out.					
	The Yag/Ti-Sapphire laser power is removed.					
	E-Stop light is out					
	A Chain Fault					
	B Chain Fault					
	5 sec audible alarm					
	Reset emergency stop fault and repeat step for remaining switches.					
18.	With one emergency stop button pressed in, press the start search button then CS-2.					
	Exit the room and press the complete search button.					
	The interlock does not activate.					
	Reset the emergency stop button.					
	Break Gun Security.					
19.	[Gun Hutch – Search and Exit Hutch]					
	Press the Start Search button located inside of the Gun Hutch.					
	LED lights come on the button box.					
	Exit the hutch, close the door, and press the Complete Search button.					
	The audible warning is a minimum of 15 seconds.					
	Gun Hutch Secure light is illuminated.					
	A Chain Fault and B Chain Fault lights are out.					
20.	“Laser Interlocked” sign is On					
	Open the Gun Hutch door.					
	Gun Hutch Secure light goes out.					
	A-chain fault light comes on					
	B-chain fault light comes on					
	The audible warning is a minimum of 5 sec.					
	“Laser Interlocked” sign is Off					
21.	Press the start search button and close door (w/assistant inside) or place jumper on door switches					
	The check station pilot light stays on for no more than 1 minute.					
	Press Complete Search (CS-E).					
	Interlock does not activate					
22.	Press interior search buttons in order in the Gun hutch, close the door, press CS-E, note that alarm comes on, open and close door, press CS-E again. (This must all be done in less than the timeout interval noted in step 19)					
	Interlock does not activate					

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 5 of 11

23. **[Gun Hutch – Internal Search]**

Enter the Gun Hutch and Close the door.

Press the Start Search button.

LED lights come on the button box.

Press the Complete Search button.

The audible warning is a minimum of 15 seconds.

Gun Hutch Secure light is illuminated.

A Chain Fault and B Chain Fault lights are out.

24. Open the Gun Hutch door.

Gun Hutch Secure light goes out.

A-chain fault light comes on

B-chain fault light comes on

The audible warning is a minimum of 5 sec.

25. Press the Start Search button and close the door remaining inside.

The check station pilot light stays on for no more than 1 minute.

Press Complete Search (CS-E) inside Gun Hutch.

Interlock does not activate

26. Press interior Start Search button, close door and remain inside. Press Complete Search inside hutch. Note that alarm comes on, open and close door, press Complete Search inside hutch again. (This must all be done in less than the timeout interval noted in step 19)

Interlock does not activate

27. Attempt to open the Gun shutter with the Gun Hutch not secured,

The shutter does not open.

28. Secure the Gun Hutch and secure the laser room.

Open the Gun shutter and reset the laser power.

Open the Gun Hutch door.

Laser power trips

Yag power supply trips off

Ti-Sapphire power supply trips off

The warning sonolert sounds for five seconds.

Gun Shutter Closes

29. Secure the gun hutch, secure the Laser room, reset the laser power, and open the Gun Hutch door. Gun shutter remains closed.

The laser power does not trip

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 7 of 11

33. *[LINAC Laser Interlock]*

LCS=Laser Check Station; LDG=Laser Door Guard

[Search]

Search the Main Laser Hutch. Secure Gun Hutch.

Close the LINAC auxiliary door and assure all persons are out of the LINAC area.

Enter the LINAC through the Main Entrance door and close the door.

Press LDG

LDG Indicator stays ON

Press LCS-1

LCS-1 Indicator stays ON

Press LCS-2

LCS-2 Indicator stays ON

Press LCS-3

LCS-3 Indicator stays ON

Press LCS-4

LCS-4 Indicator stays ON

Press LDG

Exit the LINAC area, close the main entrance door, & then press LCS-E

An audible alarm sounds for at least 15 seconds

Both "Laser Interlocked" signs are illuminated

(Main entrance door and auxiliary door near labyrinth)

LINAC Area Laser Secure indicator is ON

Gun to LINAC Shutter Enable light comes ON after audible alarm is complete.

34. With Main door (#1) & Auxiliary door (#2) closed, press the laser door guard button from the inside the LINAC area

Observe the light on the door guard box lights.

Press LCS-1 and begin timing

LCS-1 light on the button box lights.

The CS-1 light goes out in ≤ 5 minutes.

35. Press LCS-2.

The light on LCS-2 does not latch.

Press LCS-3

The light on LCS-3 does not latch.

Press LCS-4

The light on LCS-4 does not latch.

The door guard light is ON.

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 8 of 11

36. Press the laser door guard button, Open door #1, exit and close door #1, and press LCS-E.
The "Laser Interlocked" sign does not activate. _____
The CS-E light does not come on. _____
The Warning siren does not sound. _____
37. With door #2 closed and door #1 closed press the laser door guard button from inside the LINAC area.
The light on the laser door guard box lights _____
Press LCS-4
The light on LCS-4 does not latch. _____
Press LCS-3
The light on LCS-3 does not latch. _____
Press LCS2 then LCS-1.
Observe the light on LCS-2 does not latch. _____
Observe the light on LCS-1 lights and latches. _____
Press the door guard button.
Open door #1 exit and close door #1, and press LCS-E.
The "Laser Interlocked" light does not activate. _____
The LCS-E light does not stay on. _____
The Warning siren does not sound. _____
38. Leave door #1 open and press the laser door guard button.
The door guard light does not light. _____
Press LCS-1
The LCS-1 light does not latch. _____
Press LCS-2
The LCS-2 light does not latch _____
Press the LCS-3 Button
The light on LCS-3 does not latch. _____
Press LCS-4
The light on LCS-4 does not stay lit _____
Press the laser door guard button. Exit and close door #1. Press LCS-E.
The "Laser Interlocked" light does not activate. _____
The LCS-E light does not latch. _____
The Warning siren does not sound. _____
Press the Laser Interlock Off Button and open door #1
39. Press LDG, LCS-1, LCS-2, LCS-3, LCS-4, and LDG. Exit LINAC and close door.
Press LCS-E. Open the door and close the door within the time-out period and
press LCS-E.
The Interlock does not activate _____
Alarm sounds for 5 sec. _____

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 9 of 11

40.	<i>[Light Curtain]</i>		
	Complete this step by first tripping the Upper laser light curtain beam and then repeating the step and tripping the lower laser light curtain beam.	<u>Upper Beam</u>	<u>Lower Beam</u>
	Close door #1 and press the laser door guard button		
	The door guard light on the box lights		
	Press LCS-1.		
	The light on the LCS-1 box lights.		
	Press LCS-2		
	The light on the LCS-2 box lights		
	Press LCS-3		
	The light on LCS-3 box lights.		
	Break the appropriate light curtain beam.		
	The light on LCS-3 goes out.		
	Press LCS-4		
	The light on LCS-4 does latch.		
	Press LCS-3		
	The light on LCS-3 does not come ON		
	Observe the laser door guard light is Off.		
	Press the door guard button.		
	Open door #1 exit and close door #1. Press LCS-E.		
	The "Laser Interlocked" sign does not activate.		
	The CS-E light does not stay on.		
	The Warning siren does not sound.		
	Press the Laser Interlock Off button and repeat for the other light beam.		
41.	<i>[Interlock Off]</i>		
	Search and Interlock the LINAC for Laser operation.		
	Press the Interlock OFF button.		
	The laser Interlock drops out.		
	Open the door.		
	No audible warning sounds.		
42.	<i>[Gun to LINAC (GTL) Laser Shutter]</i>		
	<i>Conduct this step using both control panels.</i>		
	Search LINAC.		
	Press the GTL laser shutter Open button	<u>Internal Panel</u>	<u>External Panel</u>
	Open indicator comes ON		
	Press the GTL laser shutter closed button		
	Closed indicator comes ON		
43.	Open the GTL laser shutter		
	The shutter opens		
	A short audible sound followed by a 2-second audible signal is heard		

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 10 of 11

44. [LINAC Door Switches]
 Verify faults are cleared on the following laser power supplies:
 Faults are cleared on the two Yag power supplies _____
 Faults are cleared on Ti Saphire power supply _____
45. Reset Laser Power Trip and search Gun hutch.
 Search the LINAC for laser operation. Open GTL Laser Shutter, Gun Laser Shutter, and then Open door #1.
 LINAC Interlock drops out. _____
 Gun Laser shutter closes _____
 GTL shutter closes _____
 Two Yag power supplies trip OFF _____
 Ti Saphire Power Supply trips OFF _____
 Reset faults and search area. Repeat test for door #2.
46. [Pass-Through Function]
 Search the LINAC for Laser Operation. Open the GTL and Gun shutters.
 Press the External PASS-Through button.
 The PASS Through button indicator comes ON _____
 Open the door and enter the LINAC.
 The shutters remain Open. _____
 The power supplies remain ON _____
 Close the door within the timeout period.
 Press the Internal PASS-Through button.
 The PASS Through button indicator goes out _____
 The shutter remains Open _____
 The power supplies remain ON _____
 LINAC Laser security remains active _____
47. Open the GTL laser shutter.
 Press the Internal PASS-Through button.
 The PASS Through button indicator comes ON _____
 Open the door and exit the LINAC.
 The shutter remains Open _____
 The power supplies remain ON _____
 Close the door within the timeout period.
 Press the External PASS-Through button.
 The PASS Through button indicator goes out _____
 The shutter remains Open _____
 The power supplies remains ON _____
 LINAC Laser security remains active _____

SDL Laser Interlock Test			
Number: LS-PPS-0015	Revision: E	Effective: 2/16/06	Page 11 of 11

48. Open the GTL laser shutter and Gun laser shutter
Press the External PASS-Through button and begin timing.
GTL shutter remains Open _____
Open the main door #1.
After no more than 20 seconds the following occurs: _____ seconds
An audible warning sounds for 5 seconds _____
GTL laser shutter closes _____
Gun laser shutter closes _____
Interlock drops out _____
Two Yag power supplies trip OFF _____
Ti Sapphire power supply trips OFF _____
49. *[Emergency Stop]*
Secure Main Laser Hutch. Open GTL & Gun laser shutter.
Verify faults are cleared on the following laser power supplies:
Faults are cleared on the two Yag power supplies _____
Faults are cleared on Ti Sapphire power supply _____
- Secure LINAC for Laser Operation
Press the Emergency Stop Button (ES-16) on the logic box.
The LINAC Interlocked light goes out. _____
LINAC Area Laser Emergency Stops light comes ON. _____
Two Yag power supplies trip OFF _____
Ti Sapphire power supply trips OFF _____
GTL & Gun laser shutter CLOSES _____
Pull the Emergency Stop button out.
The Emergency Stop light remains on. _____
Reset fault using the SOR key at the Main Laser Control Panel.
The Emergency Stop Fault light goes out at the
Laser logic box. _____
50. Press the other 14 Emergency stops (ES1 - ES14) located in the LINAC area one at a time. The
Emergency Stop Fault light comes on. Reset the fault each time.
- | | | | | | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------|
| ES | ES | ES | ES | ES | ES | ES | ES | ES | ES | ES | ES | ES | ES | Gun Hutch |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | ES14 |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
51. Press the Emergency Stop (ES-17) located on the LINAC control panel.
The Emergency Stop Fault light comes on. _____
Reset ES fault.

* * *